HOW TEACHERS MAY USE PUBLICATIONS ON THE CONTROL OF BLACK STEM RUST OF SMALL GRAINS BY THE ERADICATION OF THE COMMON BARBERRY

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RANGE OF USE

All rural schools in the northern half of the United States east of the Rocky Mountains will find the material contained in these bulletins valuable. Urban schools also will find it of value in connection with courses in agriculture, nature study, or botany.

RELATION TO COURSE OF STUDY

The material contained in these bulletins may be used in secondary schools in connection with the study of botany, field crops, or plant diseases in elementary agricultural courses, or in rural grade schools as aids to presenting special lessons on black stem rust and its relation to the common barberry. It also illustrates the harm that may result from the indiscriminate introduction of plants into any region, and is of value in courses in horticulture and general science.

SOURCES OF INFORMATION

United States Department of Agriculture Farmers' Bulletin 1058, Department Circulars 269, 332, and 356, college of agriculture of State publications; and pamphlets prepared by the Conference for the Prevention of Grain Rust, 300 Lewis Building, Minneapolis, Minn., an agency cooperating with the United States Department of Agriculture.

ILLUSTRATIVE MATERIAL

Samples of small grains showing black stem rust usually can be obtained locally in rural sections, as can also samples of various wild grasses which aid in the dissemination of the rust. These should be collected, pressed, properly labeled, and kept in a permanent school herbarium for future illustrative use. Samples of the Japanese barberry can be easily obtained locally. The common barberry as eradication progresses is becoming less easily found, but a thorough search of the neighborhood should be made for it.

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Federal and State bulletins, colored charts showing the chief characteristics of the common barberry and the life cycle of black stem rust, samples of the common barberry and of rusted cereals, shriveled and plump grain, and other study material may be obtained from the State leader in barberry eradication at your State agricultural college or through the United States Department of Agriculture, Washington, D. C.

SUGGESTIONS TO THE TEACHER

The loss of grain in the principal grain-growing areas of the United States from black stem rust has increased greatly in the past 50 years somewhat in proportion to the number of common barberry bushes. Seeds from these bushes introduced and planted as shrubbery and hedges have been scattered by birds and cattle to waste lands and wooded areas. Almost every farmer who has raised grain has suffered losses from black stem rust. Effective control of this disease is of vital interest to American agriculture.

Small grains are attacked also by several other plant diseases which in some sections cause serious damage. The diseases most easily confused with stem rust are the leaf rusts of cereals, including crown rust of oats. Where the leaf rusts occur, pupils should be taught to distinguish between the leaf rusts and black stem rust, which is the only grain rust spread by the common barberry.

Read the bulletins carefully. Familiarize yourself with the answers to the questions. Allow the pupils to study the material, the bulletins, and charts before beginning any discussion on the subject. Divide the study questions into several recitation periods as thought best. Emphasize the identification of the common barberry bush. Have the pupils bring to school samples of any bushes they may believe to be common barberry and, if necessary, send the samples to your State agricultural college for identification. Encourage the pupils to ask their parents about black stem rust and the damage it does. Explain carefully the relation of the rust to the common barberry. Point out clearly that the destruction of every common barberry is absolutely necessary for the successful control of black stem rust. Encourage the pupils to look for barberry bushes. When one is found let all the neighbors see it and then report its location.

LESSON PLAN

A. Relation of common barberry to black stem rust

1. What is black stem rust?

2. Explain why and how the kernels are shriveled when rust attacks the grain plants severely.

3. How many different kinds of spores (seeds) are produced by the rust plant?

4. Name the different stages in the life cycle of stem rust.

5. Upon what plants does each stage grow?

6. Why will the eradication of the common barberry in the northern grain-growing States tend to stop the destructive rust epidemics to which the wheat-growing regions are now subject?

7. What effect does hot, muggy weather have on black stem rust? Why?

8. How is rust spread from the barberry to grains and grasses?

9. What is the color of the rust which is first produced on the grain plants after becoming infected by the rust spores from the barberry?

10. Can this red rust on the grain plants infect other grain plants? Does stem rust produce one or more than one crop of red spores during the summer? How often may a new crop of red spores be produced if weather conditions are favorable?

11. Can these red spores live through the winter in the northern part of the United States?

12. What is the color of the stem-rust spores produced on the grain when it ripens?

13. Can these black spores infect other grains directly?

14. Can they live through the winter?

15. What are the only plants on which they can produce rust in the spring?

16. Since the red spores do not ordinarily live through the winter in the northern grain-growing sections and since the black spores can produce rust only on the common barberry and a few closely related plants, what is one of the best methods of controlling rust?

17. Would the eradication of all the common barberries on one farm protect the grain on that farm from black stem rust? Why?

18. How high in the air have rust spores been found?

19. Could the barberries in a neighboring State produce rust which might be spread to the grain in your State?

B. Losses caused by black stem rust

1. Compare a sample of rust-shriveled grain with a sample of plump grain which has not been damaged by rust. Why is the market value of shriveled grain greatly reduced?

2. What is the average annual stem-rust loss in the United States; in your State; in your community?

3. Explain how common barberry bushes in your locality could affect the rust losses in the next county, even if very little grain is grown in your county.

C. Identification of the common barberry

1. Describe the appearance of the common barberry bush as to shape and size.

2. Describe the leaves, thorns, flowers, berries, outer bark, and inner bark.

3. Compare the leaves, branches, flower clusters, and berries of the common and the Japanese barberry bushes.

D. Introduction and distribution of the common barberry in the United States

1. Is common barberry native to the United States?

2. Where did it come from and how has it been distributed throughout the country?

3. Are there any harmful barberries native to North America?

4. In what States are these harmful native barberries found?

5. By what means are the seeds of common barberries scattered from a planted bush?

6. Barberry seeds have been known to lie in the ground as long as five years before germinating. How does this increase the difficulties of barberry eradication?

E. Eradication of the common barberry

1. Does your State have a law condemning the common barberry?

2. How are common barberry bushes killed?

3. Why is digging often unsatisfactory?

4. Why is it necessary to revisit properties on which common barberry bushes have been growing, even after the original bushes have been removed? (See D, Question 6; and E, Question 3.)

5. What is the danger in placing salt or kerosene on bushes growing in a lawn?

6. If you find a bush which you think is common barberry, to whom would you show or send a sample for definite identification?

7. Why should you send a sample and a notice of the location of all common barberry bushes which you may find to the State leader of barberry eradication, care of your State college of agriculture, or the United States Department of Agriculture, Washington, D. C.?

F. Other methods of black stem-rust control

1. What effect does early planting of spring grain have on stem rust?

2. How can a farmer help the grain to get a good start so that it can ripen before the rust damages it?

3. What effect have nitrogen fertilizers on grain plants and their susceptibility to rust?

4. Are there any varieties of wheat that are more susceptible to rust than others?

5. Are the agricultural experiment stations producing rust-resistant varieties of wheat? Is it possible to produce a high yielding, rust-resistant wheat of good milling quality by cross-breeding existing varieties of good milling qualities with the rust-resistant varieties?

PRACTICAL EXERCISES

Ask the pupils to bring in some of the black stage of the rust which is present on the stubble of most grain fields and examine it under a hand lens or microscope. Scrape some of the black spores from the stem into a drop of water on a glass slide. After placing a cover glass over the material examine it under the microscope. The black spores, which are two-celled, germinate the next spring after they are produced and may cause an infection on common barberry leaves which develops into the cluster-cup stage of the black stem rust.

If the red or summer stage of the rust is available, prepare a microscope slide of it. Compare the size, shape, and color of these spores with the black spores. The red spores are the spores of the repeating stage of black stem rust. During the summer a new crop of these spores may be produced every six to ten days, under favorable weather conditions. The red spores are so tiny and light that they can be blown for miles by the wind and still be capable of infecting grain plants.

Have the pupils draw a twig of the common barberry showing the chief characteristics by which the bush may be identified.

Examine one of the cluster cups on a barberry leaf. An average sized cluster cup contains from 8,000 to 15,000 spores, so that a moderately infected common barberry bush six feet high may produce millions of black stem-rust spores.

CORRELATIONS

Language

Write letters for bulletins on barberry eradication. Write a letter to some farmer telling him about the relation of the common barberry to black stem rust. Have the pupils write sentences containing the words suggested for a spelling lesson.

Arithmetic

The following figures were obtained by actual counts made on a common barberry bush of medium size:

Total number of leaves	35,000
Percentage of leaves showing rust	80
Average number of rust clusters on each infected leaf	8
Average number of cups in each cluster	36
Average number of spores in one cup of a cluster	11,500

Each of these spores might produce rust on a grain plant. If the wind distributed these spores so that one fell on each square inch of land surface, how many acres would the spores from this bush cover? (Answer, 14,784 acres.) How many square miles is this? (Answer, 23 square miles.) How many barberry bushes would it take to produce one spore for every square inch of land surface in your county?

Combined with the following facts, some amazing results may be obtained. A single red rust spot on a grain plant may produce one hundred thousand spores, each capable of causing more rust on the same or other grain plants. From the time infection occurs until a new crop of spores is formed about ten days have elapsed. Each of the new spores may repeat the process. In ordinary seasons at least four to six crops of red spores may be produced between the time the barberry begins shedding rust and the time of harvest. Fortunately, many of the spores produced fail to survive.

Geography

Study the area in which the barberry eradication campaign is being carried on. Where is most of our spring wheat grown? Winter wheat? Give reasons for clearing this area of all common barberry bushes.

Spelling

The following common words are used repeatedly in the bulletins on this subject and may be used for a spelling lesson:

barberry	destructive	cooperation	chemical	germinating
eradication	disease	campaign	kerosene	common
destroys	epidemic	yield	average	European
stem rust	damage	weather	production	grain
spore	agriculture	reduced	escaped	sprouts
Japanese	cluster cup	spine	prevention	resistant
harmless	pustule	berries		
grain	wheat			

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